BOTTOM FAUNA EVALUATIONS IN BRUCE LAKE AND DOWNSTREAM WATERS

May 1966, August 1967
and July 1968

Ontario

Ministry
of the
Environment

The Honourable
William G. Newman,
Minister

Everett Biggs,
Deputy Minister

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MAY 1966, AUGUST 1967 AND JULY 1968

by
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Previously
Biology Branch
Ontario Water Resources Commission

ANKC

In December of 1965, the Steel Company of Canada made application to the Commission for construction and operation of facilities for the removal and impoundment of silt overburden and mill tailings as part of the development of its iron mining properties in the Township of Bruce in the Red Lake District of Northwestern Ontario. Approval for construction of a dyke to section Bruce Lake was granted by the Department of Lands and Forests under the Lakes and Rivers Improvement Act. Subsequently, the application for pollution control measures received approval from the Commission in accordance with terms of the OWRC Act. In so doing, it was recognized by the Commission that even with strict adherence to terms set down by the Commission, 100% retention of the silt overburden removed by the dredging operations could not be achieved; hence some acceptable increases in solids, turbidity and colour of downstream waters would be unavoidable.

In order to determine potential effects associated with the mining operation, studies of benthic aquatic communities were initiated by the Biology Branch of the Commission. The first survey was carried out in May of 1966, at which time the receiving waters were in their natural state. Subsequently, dredging and milling operations have been under routine surveillance by the Division of Industrial Wastes (reported elsewhere) and repeat evaluations of the bottom fauna have been made on two occasions. This report presents the findings of bottom fauna surveys of Bruce and Pakwash lakes between May 1966 and July 1968.

BIOLOGICAL APPROACH TO WATER QUALITY MONITORING

The spectacular forms of pollutants such as organics and toxics provoke a more or less predictable and readily measurable response by the aquatic community. In contrast, the pollutional effects of suspended inorganic particulate matter are difficult to detect. For example, many wilderness rivers such as the Little and Big Pic are turbid of natural origin and carry a heavy silt load, but such rivers support viable populations of aquatic organisms. Where turbidity is introduced into a previously stable environment, a community shuffle may result until a new community equilibrium is established. If turbidity increases sufficiently, phytoplankton production may decrease which in turn limits the production of zooplankton and aquatic insects essential as food for fish, so that serious consequences for fish life may result.

The biological approach to water quality monitoring in Bruce and Pakwash lakes has been to examine the bottom fauna community, with particular attention being paid to any changes in the phytoplankton-feeding segment. This approach considers only community energetics; other potential effects of increasing the inorganic particulate matter include possible destruction of spawning beds by silt, sublethal damage to fish and a possible avoidance response by fish of the turbid waters. The fish of Bruce and Pakwash lakes have been under investigation by the Ontario Department of Lands and Forests.

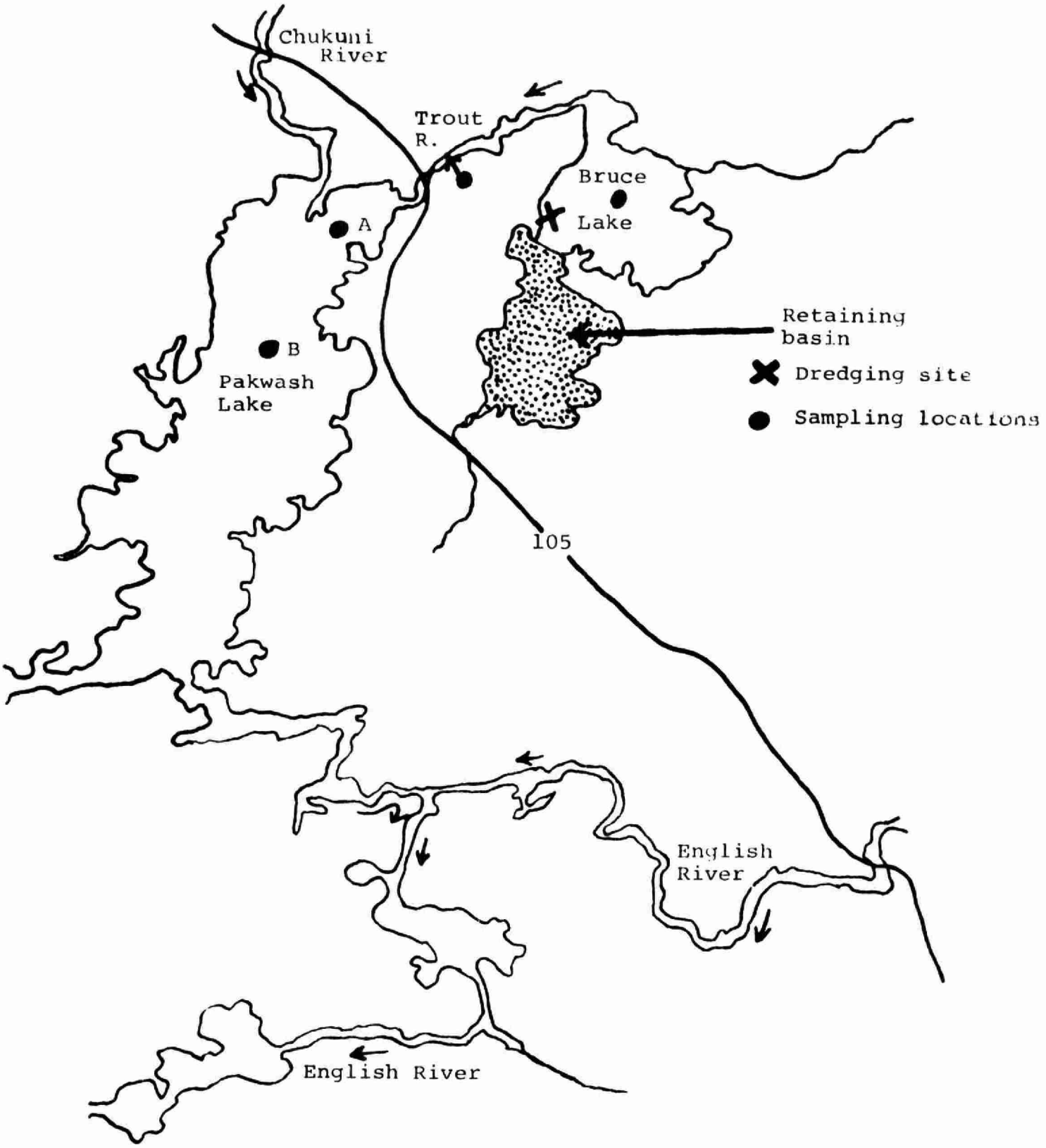

Fig. 1. Bruce and Pakwash Lakes showing dredging site, retaining basin and biological monitoring locations.

SURVEY METHODS

Bottom fauna samples from Bruce Lake and downstream waters were collected in May of 1966, August of 1967 and July of 1968. Sampling locations were (1) Bruce Lake, northern basin, (2) Trout River, (3) Pakwash Lake, near mouth of Trout River, and (4) Pakwash Lake, north-central basin. (see figure). Samples of the substratum were dredged and screened to remove the sediment. The invertebrates retained by the screen were preserved in 95% alcohol prior to being returned to the laboratory for enumeration and identification.

FINDINGS

Table 1 lists the variety and distribution of bottom fauna secured from Bruce Lake and downstream waters for the years 1966, 1967 and 1968. Generally, these data demonstrate that the variety of bottom fauna has not been altered as a result of dredging activities on Bruce Lake. A total of nine taxa of macroinvertebrates were secured from Bruce Lake, the Trout River and Pakwash Lake during the 1966 pre-operational survey. Sampling in 1967 and 1968 re-confirmed the presence of all forms of bottom fauna detected in 1966. One additional taxa was present in 1967 and three new taxa were revealed in 1968. This increase in diversity was undoubtedly attributable to seasonal and sampling variability. Of significance is the fact that none of the indigenous species have been eliminated.

In terms of density, frequency of occurrence, biomass and potential value as fish food the mayfly Hexagenia, the midge Chironomus and clams Sphaerium and Pisidium were

Table 1. Variety and distribution of macroinvertebrates collected from Bruce Lake and downstream waters for the years, 1966, 1967 and 1968. (p = present)

	Bruce Lake			Trout River			Pakwash Lake					
	1966	1967	1968	1966	1967	1968	1966	1967	1968	1966	1967	1968
								A			B	
Mayflies	p	p	p	p	p	p	p	p	p	p	p	p
Alderflies	p	p	p	p	p	p	p	p	p	p	p	p
Caddisflies												p
True Midge	p	p	p	p			p	p	p	p	p	p
Phantom Midge	p	p	p					p		p	p	p
Biting Midge		p	p			p						
Amphipods		p							p		p	p
Clams	p	p	p	p	p	p	p	p	p			p
Snails									p			p
Worms		p										p
Leeches												p
Ostracods		p	p			p			p			p
Mites			p									
TOTAL TAXA	5	9	8	4	3	5	4	5	7	4	5	11

Table 2. Densities (number per square foot) of selected filter feeding organisms secured from Bruce Lake and downstream waters for the years 1966, 1967 and 1968.

		Mayflies	Clams	True Midge
Bruce Lake	1966	2.8	.7	7.0
	1967	6.5	.5	3.8
	1968	4.8	2.1	3.0
Trout River	1966	5.3	31.6	4.0
	1967	11.3	19.3	0
	1968	4.3	27.0	0
Pakwash Lake "A"	1966	6.6	1.2	20.2
	1967	20.2	1.4	1.8
	1968	15.4	2.2	1.6
Pakwash Lake "B"	1966	4.7	0	2.3
	1967	9.3	0	1.7
	1968	19.7	1.3	1.8

the most significant components of the normal benthic communities of Bruce and Pakwash lakes. This is particularly noteworthy because all of these organisms are filter feeders and as such are most vulnerable to damage from increased particulate inorganic matter. Therefore, to further examine the data for symptoms of distress, densities of these organisms before and after dredging operations commenced are listed in Table 2. In comparison with the control populations of 1966, a marked increase in the densities of mayfly naiads was apparent for the years 1967 and 1968. Similarly, a general trend towards higher densities of clams was apparent in the post-operative years. In contrast, densities of the midge Chironomus showed a general decline in abundance following the pre-operative survey of 1966.

While dredging activities on Bruce Lake have affected noticeable increases in the turbidity of Bruce Lake and connected waters, examination of bottom fauna communities before and after dredging activities commenced suggested that the environment has not been unfavourably altered for the production of indigenous aquatic life. Generally, more forms of bottom fauna were present, they were more widely distributed and were more abundant in 1967 and 1968 than during the pre-operative period of 1966. The only major post-operative reduction for one of the three major taxa related to numbers of the midge Chironomus. This decline may be explained at least in part by the difference in sampling dates of the various surveys. Bottom fauna were sampled in May of 1966, August of 1967 and July of 1968. According to Hilsenoff (1966) the midge Chironomus exhibits two cycles per year. Larvae which overwinter in Wisconsin emerge in May and their progeny emerge in July or August of the same year. The progeny of the second hatch provide the overwintering larvae. The exact hatching dates are temperature-dependent. This being true, it is probable that larvae of the midge Chironomus had emerged prior to the sampling periods of 1967 and 1968. In any event, it is safe to conclude that dredging activities at the Griffith Mine site have not unduly affected the ability of Bruce Lake and downstream waters to produce adequate numbers of fish food organisms.

REFERENCE

HILSENOFF, W. L. 1966. The Biology of Chironomus plumosus (Dipteran: Chironomidae) in Lake Winnebago, Wisconsin. Annals of the Entomological Soc. of America 59(3): 465-73.

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